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Patent Family:

Patent No	Kd Date	Applic No	Kd Date	Wk Added
AU 197617926	A	19780817	AU 197617926	D 19760920 200013
AU 197728340	A	19790308	AU 197728340	D 19770829 200013
AU 502953	B2	19790816	AU 197728340	A 19770829 200013
BE 847422	A1	19770214	BE 171621	A 19761019 200013 (B)
CA 1067297	A1	19791204	CA 262106	A 19760927 200014
DE 2645986	A1	19771020	DE 2645986	A 19761012 200015
DE 2645986	C2	19850117	DE 2645986	A 19761012 200015
ES 452247	A1	19771201	ES 1976452247	A 19761008 200014
FR 2346959	A1	19771104	FR 197631429	A 19761019 200015
FR 2346959	B1	19811224	FR 197631429	A 19761019 200015
GB 1559991	A	19800130	GB 197633631	A 19760812 200016
IT 1062298	B	19840706	IT 197651503	A 19760929 200014
JP 52122555	A	19771014	JP 197693921	A 19760806 200017
JP 54132660	U	19790913	JP 197920981	U 19790220 200441
JP 59124425	U	19840822	JP 1983193055	U 19831216 200406
JP 59127420	U	19840828	JP 1983193056	U 19831216 200406
MX 143201	A	19810402	MX 166597	A 19761007 200014
SE 197612521	A	19771008	SE 197612521	D 19761110 200018
SE 197612521	L	19771008	SE 197612521	D 19761110 200736
SE 413363	B	19800527	SE 197612521	A 19761110 200018
SE 413363	C	19800911	SE 197612521	A 19761110 200018
US 4112653	A	19780912	US 1976674323	A 19760407 200018
US 4382356	A	19830510	US 1981290250	A 19810805 200018
YU 19762089	A1	19830427	YU 19762089	A 19760827 200018
ZA 197605489	A	19770831	ZA 19765489	A 19760914 200021

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US 1976674323 A 19760407  
AU 197728340 A 19770829  
US 1981290250 A 19810805

BELGIUM (BE) LEGAL STATUS:

Legal Status (Patent No,Kind,Gazette Date,Code,Text):

BE 847422 A1 19920430 BE RE (-) LAPSED (BREVET DECHU)  
Assignee(s): WHITE CONSOLIDATED INDUSTRIES  
INC.  
Effective Date: 19911031  
Last Revised by EPO: 20030101  
Update Week: Backfile

GERMANY (DE) LEGAL STATUS:

Legal Status (Patent No,Kind,Gazette Date,Code,Text):

DE 2645986 A1 19821216 DE 8128 NEW PERSON/NAME/ADDRESS OF THE  
AGENT (AENDERUNG IN PERSON, NAMEN ODER  
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Attorney(s): HENKEL, G., DR.PHIL. FEILER,  
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Last Revised by EPO: 20030101  
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DE 2645986 A1 19830630 DE 8127 NEW PERSON/NAME/ADDRESS OF THE  
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Last Revised by EPO: 20030101  
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DE 2645986 A1 19830630 DE 8128 NEW PERSON/NAME/ADDRESS OF THE  
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MUENCHEN PFENNING, J.,  
Last Revised by EPO: 20030101  
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DE 2645986 A1 19850117 DE D2 (+) GRANT AFTER EXAMINATION  
(PATENTERTEILUNG NACH DURCHFUEHRUNG DES  
PRUEFUNGSVERFAHRENS)  
Last Revised by EPO: 20030101  
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DE 2645986 A1 19850711 DE 8364 (+) NO OPPOSITION DURING TERM OF  
OPPOSITION (EINSPRUCHSFRIST ABGELAUFEN OHNE  
DASS EINSPRUCH ERHOBEN WURDE)  
Last Revised by EPO: 20030101  
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DE 2645986 A1 19880526 DE 8327 CHANGE IN THE  
PERSON/NAME/ADDRESS OF THE PATENT OWNER  
(AENDERUNG IN PERSON, NAMEN ODER WOHNORT DES  
PATENTINHABERS)  
Assignee(s): WHITE CONSOLIDATED INDUSTRIES,  
INC., CLEVELAND, OH  
Last Revised by EPO: 20030101  
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DE 2645986 A1 19880526 DE 8328 CHANGE IN THE  
PERSON/NAME/ADDRESS OF THE AGENT (AENDERUNG  
IN PERSON, NAMEN ODER WOHNORT DES VERTRETERS)  
  
Last Revised by EPO: 20030101  
Notes: HENKEL, G., DR.PHIL. FEILER, L.,  
DR.RER.NAT. HAENZEL, W., DIPL.-ING. KOTTMANN,  
D., DIPL.-ING, PAT.-ANWAELTE, 8000 MUENCHEN  
Update Week: Backfile

DE 2645986 A1 19921008 DE 8339 (-) CEASED/NON-PAYMENT OF THE  
ANNUAL FEE (WEGEN NICHTZ. D. JAHRESGEB.

ERLOSCHEN)  
Last Revised by EPO: 20030101  
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FRANCE (FR) LEGAL STATUS:

Legal Status (Patent No,Kind,Gazette Date,Code,Text):  
FR 2346959 A1 19820702 FR TP TRANSMISSION OF PROPERTY  
(TRANSMISSION DE PROPRIETE)  
Last Revised by EPO: 20030101  
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FR 2346959 A1 19880506 FR TP TRANSMISSION OF PROPERTY  
(TRANSMISSION DE PROPRIETE)  
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FR 2346959 A1 19920828 FR ST (-) LAPSED (CONSTATATION DE  
DECHEANCES)  
Last Revised by EPO: 20030101  
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GREAT BRITAIN (GB) LEGAL STATUS:

Legal Status (Patent No,Kind,Gazette Date,Code,Text):  
GB 1559991 A 19800416 GB PS (+) PATENT SEALED  
Last Revised by EPO: 20030101  
Update Week: Backfile  
  
GB 1559991 A 19880615 GB 732 REGISTRATION OF TRANSACTIONS,  
INSTRUMENTS OR EVENTS IN THE REGISTER (SECT.  
32/1977)  
Last Revised by EPO: 20030101  
Update Week: Backfile  
  
GB 1559991 A 19920408 GB PCNP (-) PATENT CEASED THROUGH  
NON-PAYMENT OF RENEWAL FEE  
Last Revised by EPO: 20030101  
Update Week: Backfile

SWEDEN (SE) LEGAL STATUS:

Legal Status (Patent No,Kind,Gazette Date,Code,Text):  
SE 413363 B 19950131 SE NUG (-) PATENT HAS LAPSED (PATENT HAR  
UPPHOERT ATT GAELLA)  
Effective Date: 19920604  
Last Revised by EPO: 20030101  
Update Week: Backfile

Abstracts:

CA 1067297 A1 19791204 (English) LAWN MOWER A rotary-type lawn mower is provided with cutting means comprised of a rotatable disc-like member having a plurality of flexible non-metallic cords projecting radially from its perimeter. The disc-like member is rotated within the cutting plane by a suitable power source such as a conventional gasoline-driven engine, and at a velocity such that the projecting cords function to sever the grass in a substantially conventional manner. The cords are therefore of a length and diameter which are functionally related to effective cutting and are mounted within the disc-like member in brackets formed to support the cords against

vertical as well as lateral deflection resulting from contact with the grass sought to be cut.

US 4382356 A 19830510 (English) A rotary-type lawnmower having unique non-metallic cutting elements carried on a rotating disc-like head with a smooth rim and lower exposed surface without significant projections or recesses capable of inflicting injury to human parts. The lawnmower produces a smooth and even cut equal to rotary metal-blade machines. The cutting elements are tapered pins extruded from flexible polymeric material such as Nylon TM polymer. Each cutting pin has a first portion providing supporting surfaces and an enlargement for securing the pin into the head. The cutting pins extend from the head in a tapered free-traveling end portion to a cutting end located at a cutting plane adjacent the ground's surface. The cutting pins are slidably inserted and removed from the disc.

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(11) AU-E1-28340/77

(12) PATENT SPECIFICATION  
ABRIDGEMENT  
(19) AU

- (21) 28340/77 502,953 (22) 29.8.77  
(23) 29.8.77 (24) 7.4.76  
(43) 9.3.79 (44) 16.8.79  
(51)<sup>2</sup> A01D 35/26 A01D 35/262 A01D 53/14 A01D 55/18.  
(54) CORD MOWER.  
(62) 17926/76.  
(71) WEED EATER, INC.  
(72) BALLAS, G.C., MITCHELL, A.W.  
(74) SW  
(56) 17140/76 A01D  
87941/75 A01D  
65126/74 488689 32.21

(57) CLAIM 1. A rotary-type lawn mower of the kind having a wheeled chassis adapted to travel over a greensward and carrying a motor having a rotatable shaft characterised by the provision therein of:

a head member having at least one peripheral aperture and mounted on said shaft for rotation in a cutting path aligned substantially parallel with said greensward and intersecting vegetation thereon,

at least one non-metallic cord-like cutting member disposed partially in said head member and having a finger-like free travelling end portion extending from said aperture outwardly of said head member into said cutting path, and

support means having an elongate passageway connecting with, and extending within said head member from, said aperture for restraining an adjacent portion of said cutting member along a length sufficient to support said free travelling end portion of said cutting member against deflection from said cutting path by said vegetation.

FORM 1

REGULATION 9

502,953

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952-1976

APPLICATION FOR A PATENT.

We, WEED EATER, INC., a corporation of the State of Delaware, United States of America, of 5146 Richmond Avenue, Houston, in the State of Texas, United States of America, hereby apply for the grant of a Patent for an invention entitled:-

2834077

"LAWN MOWER AND METHOD"

which is described in the accompanying Complete Specification.

This application is a separate application made by virtue of sub-section (1) of Section 49A of the Patents Act 1952-1976 in respect of an invention disclosed in the Complete Specification lodged in respect of Application No. 17926/76.

Our address for service is:-

SHELSTON WATERS,  
55 CLARENCE STREET,  
SYDNEY, N.S.W. 2000.

APPLICATION ACCEPTED AND AMENDMENTS

ALLOWED

DATED this 26TH day of AUGUST, 1977

WEED EATER, INC.

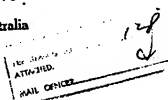
by Robert. G. Shelston.

Fellow Institute of Patent Attorneys of Australia  
of SHELSTON WATERS

To: The Commissioner of Patents,  
WODEN. A.C.T. 2606.

File: D.B.112J RGS/ID.

Fee: \$128.00.



**FORM 7—REGULATION 12 (1)**

RECEIVED

SECRET

PATENT DEPT.

28340 m

**COMMONWEALTH OF AUSTRALIA**

**PATENTS ACT, 1952-1969**

**DECLARATION IN SUPPORT OF AN APPLICATION FOR A PATENT.**

(a) Here Insert (in full)  
Name of Company.

In support of the Application made by (a)

WEED EATER, INC

(hereinafter referred to as "Applicant") for a patent for an invention entitled:

(b) Here insert Title of Invention.

## "LAWN MOWER AND METHOD

(c) Here insert Full Name and Address of Company Official authorized to make declaration.

(u) John H. Bannerman, Secretary, Weed Eater, Inc.,

of 5146 Richmond Avenue, Houston, Texas 77056.

United States of America

**do solemnly and sincerely declare as follows:**

**1. I am authorised by Applicant to make this declaration on its behalf.**

(c) Here insert (in full)  
Name and Address of  
Actual Inventor(s).

2 (u) George Charles Ballas of 5146 Richmond Avenue,

Houston, Texas, and Albert Wesley Mitchell of 8902

Lazy River, Houston, Texas, both of United States of

America ~~to~~ are the actual inventor(s) of the invention and the facts upon which Applicant is entitled to make the Application are as follows:

Applicant is the Assignee of ~~the said Inventor(s)~~ Weed Eaters, Inc., who are the Assignees of the said Inventors.

Declared at Houston, Texas

this 22 nd day of September 1977.

(a) Personal Signature  
of Declarant (c) (no  
seal, witness or  
juratification).

**TO THE COMMISSIONER OF PATENTS.**

# COMPLETE SPECIFICATION

## 502,953

FOR OFFICE USE:

Class Int. Class

Application Number:  
Lodged:

28340m

This document contains the  
statements made under  
section 49.

and is correct for printing.

3 AUG 1979

Complete Specification Lodged:  
Accepted:  
Published:

Priority:

Related Art:

Name of Applicant: WEED EATER, INC.

Address of Applicant: 5146 Richmond Avenue, Houston, United States of  
America

Actual Inventor: GEORGE CHARLES PALLAS AND ALBERT WESLEY MITCHELL

Address for Service: Shelston Waters, 55 Clarence Street, Sydney

Complete Specification for the invention entitled: "LAWN MOWER AND METHOD"

The following statement is a full description of this invention, including the best method of performing it known to me/us:—

DIVISIONAL OF Appln.No.17926/76  
DATED 20th September, 1976.

— 1 —



# LAWN MOWER AND METHOD

## Abstract

A rotary-type lawn mower is provided with cutting means comprised of a rotatable disc-like member having a plurality of flexible non-metallic cords projecting radially from its perimeter. The disc-like member is rotated within the cutting plane by a suitable power source such as a conventional gasoline-driven engine, and at a velocity such that the projecting cords function to sever the grass in a substantially conventional manner. The cords are therefore of a length and diameter which are functionally related to effective cutting and are mounted within the disc-like member in brackets formed to support the cords against vertical as well as lateral deflection resulting from contact with the grass sought to be cut.

## Background of Invention

This invention relates to methods and apparatus for cutting vegetation and the like, and more particularly relates to improved lawn mowing methods and apparatus.

It is now common practice to provide a greensward in conjunction with most residential and other structures intended for human use and occupancy, not only to enhance the overall esthetic appeal of such structures, but also to provide an area associated therewith for purposes of recreation and relaxation. It is also common practice to maintain such greensward in a mowed condition to further enhance its usefulness in this regard, and thus various forms of mowing devices have been devised and employed to more effectively mow such areas.

Many different forms of apparatus have been devised and

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made available for mowing a greensward and the like, although most of these devices may be characterized as either a "reel-type" mower or a "rotary-type" mower. Both of these types of mowers are sufficiently well known so as not to require explanation, except to note that they both employ one or more moving steel blades to sever the grass to a substantially uniform height. It is also well known that the rotary-type mower is inherently more dangerous to persons and property. It is also the most popular type of mower because it is easier to use and also because it is better suited to areas where the grass is either tall or thick or both.

What has not been generally appreciated is the likelihood of serious injury attaching to the use of a conventional rotary-type lawnmower employing a rigid steel blade. However, the National Electronic Injury Surveillance System has estimated that, during 1973 alone, there were 53,350 mower-related accidents serious enough to require hospital treatment.

The manufacturers of rotary-type lawnmowers have not been indifferent to this problem, of course, and have made strenuous efforts to provide against such injuries. For example, all mowers are provided with covers or "shrouds," not only to enclose the blade but also to route stones and other debris struck by the blade along a restricted predetermined route. In addition, these mowers are mounted on widely spaced wheels of relatively small diameter so as to improve their stability. There is a practical limit to such measures, however, and thus a conventional rotary-type mower will apparently always constitute a source of

serious injury.

Because of this problem, there have been various attempts to change the basic design of this type of mower or to adopt other radical changes. For example, there is shown in U.S. Patent No. 2,557,598 a lawn mower which is generally conventional in its overall appearance but wherein the rigid steel blade has been replaced by a disc having a plurality of metal wires extending radially from its perimeter. These wires have substantially less mass than a conventional mower blade, of course, and they are more flexible, and thus more yieldable, under impact. Nevertheless, a revolving steel rod or wire is only slightly less dangerous than a rigid blade, and will project debris with only slightly less force. Also, such a mower is significantly less effective for grass-mowing purposes.

In U.S. Patent No. 3,091,915, there is disclosed another lawn mower wherein the lower portion of the shroud is provided with a grille-like plate with apertures for admitting the upward thrust ends of the grass and with honed edges at the apertures in the grille plate. The blade is replaced with a brush-like assembly which revolves over the plate to "wipe away" the grass ends sought to be cut, by drawing them over the honed edges in the grille. The bristles of the brush assembly are sufficiently stiff so as to cause the grass to be severed, but they are also sufficiently flexible so as not to project debris in a dangerous manner or to injure any portion of the body which may be inadvertently inserted through the grille member. There can be no dispute that such an arrangement, wherein the cutting member (the grille) is held stationary,

is inherently safer than is a revolving steel cutting blade. Cutting effectiveness is basically a function of impact, however (except in a scissor-like arrangement), and thus a mower of this design is only limitedly effective when used in areas having high or dense vegetation.

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10 In U.S. Patent No. 3,208,209, the conventional rigid blade is replaced with a disc-like member having a plurality of relatively short and resilient wires extending from its periphery. When the disc-like member is revolved, the wires are sufficiently stiff so as to sever vegetation, but are sufficiently flexible so as to yield to any so-called "foreign" object. As will hereinafter be made apparent, however, such an arrangement will not achieve effective mowing without the addition of other features.

10 In U.S. Patent No. 3,302,377, there is disclosed a novel cutting member intended to replace the rigid blade in a conventional rotary-type mower and which is formed of composite molded rubber reinforced longitudinally by less elastic fibers. It is claimed that such a blade will either yield to foreign objects such as a shoe sole and the like, or will discharge rocks and other debris at safer velocities. It is also admitted, however, that such a blade is subject to wear during use and that it has a limited useful lifetime.

30 In U.S. Patent No. 3,320,732, there is disclosed apparatus which is also intended to replace the conventional rigid metal blade in a rotary lawnmower and which includes a revolvable disc having a pair of non-metallic blades mounted at opposite points on its perimeter. Although the blades are preferably formed of a plastic such as polyurethane, they are intended to be wide enough so as to be substant-

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ially rigid, whereby effective cutting is achieved. On the other hand, pivotally attaching the blades to the disc permits them to yield upon encountering a foreign object.

Other examples of devices and apparatus intended to replace the rigid steel blade in a conventional rotary lawnmower may be found in U.S. Patents Nos. 3,340,682, 3,389,541, 3,444,675, 3,474,608 and 3,664,102. However, none of these or the other innovations cited herein have been a solution to the problem, and thus the rotary lawnmower with a rigid steel blade has continued to be the most widely used device for these purposes.

Recently, a completely new type of vegetation cutting device has been developed and marketed under the registered trademark "Weed Eater," which device is depicted generally in U.S. Patents Nos. 3,708,967, 3,826,068 and 3,859,776, and which employs one or more flexible non-metallic cords which are revolved to function as cutting elements. This type of device has enjoyed spectacular commercial success as an edger/trimmer, since it provides a number of advantages which cannot be found in conventional cutters. For example, these cutters are capable of reaching into areas not accessible to rigid steel blades and the like, and thus the Weed Eater trimmer can remove weeds and other vegetation located in close proximity to walls, fences, trees and even within crevices in such walls and the like, without damage to such walls and trees. Second, and more important for present purposes, the Weed Eater trimmer is substantially completely safe to operate since the revolving cords will cause injury under only the most unusual circum-

stances.

Because of these advantages, as well as others, it has been proposed to construct a lawn mower incorporating this principle to thereby eliminate the hazards which are inherently present with conventional mowers. More particularly, it has been proposed to replace the rigid steel blade in such mowers with a head assembly having one or more such flexible cords and to revolve such assembly and cords to sever the grass on a greensward. This proposal has proved to be deceptively oversimple, however, and is based on a misconception that the Weed Eater edger, as presently built and marketed, is the functional equivalent of a conventional lawn mower. Accordingly, all such attempts to construct an operable lawn mower employing such a cutting element have hitherto been failures for the reasons hereinafter set forth.

It is common practice to broadly characterize all powered grass and weed cutting devices as "lawn mowers," excepting those machines intended to be used by commercial agriculturalists and the like. There is a basic functional distinction between a lawn mower per se, however, and a device which is more accurately denoted as an "edger/trimmer," and this distinction must be clearly understood to appreciate the reason why it has not been possible to merely replace a steel blade with a Weed Eater trimmer head assembly.

The basic principle of any lawn mower per se is that the cutting element or elements are manipulated strictly within a cutting plane which is fixedly located relative to the surface of the area being mowed. The reason for

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this is that the very concept of "mowing" contemplates the leveling of the grass to produce a carpet-like effect, and thus the blade must be rotated in a plane which is fixedly positioned relative to the surface of the earth. Otherwise, the greensward would have a ragged, uneven appearance after being cut, and this is not the effect or result sought to be achieved.

20 When a rigid steel blade is revolved in this plane, it yields to the grass only to the extent that it may tend to slow, but it does not become warped or distorted so as to be deflected from its intended cutting plane. If a flexible non-metallic string is revolved to cut vegetation, however, it yields to the grass in various ways. In particular, it not only yields laterally in that it assumes a curvilinear configuration, but it also tends to be deflected upward by the grass it is cutting. Accordingly, if the cords of a Weed Eater are brought into contact with resistant vegetation, these cords tend to move in a cutting "plane" which actually has a warped configuration.

30 This warping effect is an advantage of the Weed Eater edger/trimmer, since it is this which enables its user to manipulate its cords to cut away the most inaccessible vegetation. When a mower is constructed in the manner of the Weed Eater trimmer, however, this warping effect tends to produce swaths having convex configurations, and this is extremely undesirable from an esthetic standpoint.

0 An edger/trimmer, and especially the Weed Eater trimmer, is not intended as a leveler, per se, but as hereinbefore stated, is intended to reach vegetation growing in otherwise inaccessible locations. Thus, an

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edger/trimmer must provide a cutting plane which can be manipulated into a variety of angles with respect to the surface of the earth and, in the case of the Weed Eater edger, must be capable of non-alignment of its cutting elements relative to its normal cutting plane. The Weed Eater trimmer as presently designed and marketed is carried by the operator so as to facilitate such manipulation. Even an edger/trimmer using a revolving steel blade is supported on no more than two spaced-apart wheels in order that its cutting plane may be tilted as needed.

Another functional difference between a rotary-type mower and an edger/trimmer is the diameter of their cutting planes. Cutting actually is accomplished at the tip of the cutting element, whether the element is a flexible cord or a rigid steel blade, and since cutting is a function of tip velocity, it will be apparent that the diameter of the cutting plane must be such as to provide for effective cutting. In the case of a lawn mower, however, the prime consideration in selecting the proper diameter of the cutting plane is the width of the swath sought to be cut.

#### Theory of Invention

These disadvantages of the prior art are overcome with the present invention, and novel methods and apparatus are provided for mowing a greensward. More particularly, a rotary-type lawnmower is provided which has a generally conventional configuration, but wherein the rigid steel cutting blade is replaced by a rotatable disc having a plurality of flexible non-metallic cords extending radially therefrom as generally shown in U.S. Patent No. 3,208,209,



whereby the grass may be cut with safety to personnel and property. As will hereinafter be explained in detail, however, other provisions are made whereby the greensward may also be cut as effectively as with a rotating steel blade.

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The diameter of the rotatable disc is functionally determinative of the velocity of the tips of the cords, of course, and therefore functionally determinative of their cutting effectiveness. However, the diameter of the disc member is also determinative of the width of the swath sought to be cut, and a typical swath is 18-22 inches wide. In an ideal embodiment of the invention, therefore, a conventional lawnmower will contain a single disc member having a diameter of approximately 15-1/2 to 19 inches, and with one or more flexible cutting lines each radially extending approximately 1-1/4 inches from its perimeter.

It has been determined that, in a Weed Eater trimmer, a single cord will cut almost as well as will a plurality of such cords, and that the principal advantage to be gained from a plurality of such cords is that the apparatus will continue to cut grass and weeds until all of the cords are broken. In a lawnmower employing cutting members of this type, however, it has been found that there are substantial advantages to using two-four cords arranged equidistantly about the disc.

The cords are preferably each mounted in the disc member in a bracket which has a curvilinear line-bearing surfaces at the perimeter of the disc, in order to support the line against excessive breakage, and which is also preferably formed of a metal or other material having a

thermal coefficient different from the material from which the lines are formed. In addition, these brackets are also preferably formed to support the cord against vertical as well as lateral deflection during the cutting operation.

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The overall length of these cords is apparently as significant a factor with respect to deflection as is the length of the portion extending outwardly from the perimeter of the disc member. Accordingly, it has been determined that the ideal cutting member for these purposes is a monofilament nylon strand having an overall length at least twice the length of its extended or free travelling portion, and that its diameter is on the order of 0.100 inches or greater.

Briefly then the invention consists in a rotary-type lawn mower of the kind having a wheeled chassis adapted to travel over a greensward and carrying a motor having a rotatable shaft characterised by the provision therein of:

a head member having at least one peripheral aperture and mounted on said shaft for rotation in a cutting path aligned substantially parallel with said greensward and intersecting vegetation thereon,

20. at least one non-metallic cord-like cutting member disposed partially in said head member and having a finger-like free travelling end portion extending from said aperture outwardly of said head member into said cutting path, and

support means having an elongate passageway connecting with, and extending within said head member from,

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said aperture for restraining an adjacent portion of said cutting member along a length sufficient to support said free traveling end portion of said cutting member against deflection from said cutting path by said vegetation.

These and other features and advantages of the present invention will become apparent from the following description, wherein reference is made to the figures 1-10 in the accompanying drawings.

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Drawings

Figure 1 is a pictorial representation of a rotary lawnmower having a cutting means embodying the present invention.

Figure 2 is a pictorial representation of one form of cutting means suggested in the apparatus depicted in the present invention.

Figure 3 is a different pictorial representation of the apparatus depicted in Figure 2.

Figure 4 is a pictorial view, partly in cross section, of a portion of the apparatus depicted in Figure 2.

Figure 5 is another pictorial representation of the apparatus depicted in Figure 1.

Figure 6 is a pictorial representation of the configuration of swaths cut in a greensward.

Figure 7 is a pictorial representation of another form of apparatus embodying the present invention.

Figure 8 is another pictorial representation of the apparatus depicted in Figure 7.

Figure 9 is a pictorial representation of a portion of the apparatus suggested in Figure 8.

Figure 10 is another view of the apparatus depicted in Figure 9.

#### Detailed Description

Referring now to Figure 1, there may be seen a pictorial illustration of a conventional rotary lawn mower 2 which has been modified to incorporate the principles of the present invention. More particularly, the lawn mower may be seen to have a chassis 3 supported upon a plurality of spaced apart wheels and to be further provided with a shroud 5 for containing a suitable cutting assembly 8 which, in turn, is rotated in a horizontal manner relative to the surface of the earth by suitable engine 6 or other driving means. A suitable handle 7 may also be provided for steering the lawn mower 2 in a conventional manner.

Referring now to Figures 2-4, there may be seen a more detailed pictorial illustration, partly in cross-section, of the cutting assembly 8 suggested in the apparatus depicted in Figure 1. More particularly, the cutting assembly may be seen to be a dish-like plate member 10 which is concentrically mounted on the shaft 9 of the motor or engine 6 and having a plurality of non-metallic flexible cord members 11 projecting radially from its periphery. As may further be seen, each cord member 11 is peripherally mounted within a bracket or supporting member 12 having a channel-like aperture for holding the member 11 in a manner such as to support the cord against vertical as well as

lateral deflection due to contact with the grass sought to be cut. The cord member 11 may also be conveniently provided with a retainer means 13 having the configuration of a sleeve member which supports the cord member against being thrown out of the bracket member 12 due to rotation of the plate 10. As further indicated in Figures 2 and 4, the plate member 10 may be comprised of a lower member 10a with a ring-like upper member 10b mounted so as to enclose and support the bracket members 12 in a proper manner.

Accordingly, it will be seen that the cord members 11 not only project from an aperture from within the bracket member 12, but also through a suitable aperture in the rim of the lower portion 10a of the plate member 10.

As hereinbefore explained, when the plate member 10 is revolved, the outwardly projecting cord members 11 act to sever the grass as they are revolved within a cutting plane defined by their tips. The lawn mower 2 will be moved progressively in a forward manner so as to cut a suitable swath across the lawn or greensward. As the plate member 10 is revolved, the cord members 11 will accordingly intersect and sever the grass immediately confronting the lawn mower 2, and will not encounter grass except in front of the lawn mower 2. As hereinbefore explained, however, there is a tendency for the cord members 11 to be deflected not only laterally in a swept-back manner, but also to be deflected upwardly in a vertical manner with respect to the plate member 10. Furthermore, as the cord member 11 encounters vegetation in a thicker condition (as it does by rotating across the swath), this vertical deflection will be a function of a thickness of the vegetation. Accordingly,

as the cord member passes from the front of the lawn mower 2 and is rotated back towards its rear, the cord member then will drop in a vertical manner to produce an oscillating effect which is undesirable in so far as producing an evenly mowed appearance across the greensward.

Referring to Figures 5 and 6, there may be seen a pictorial illustration of the configuration of the swath cut by the rotating cord members 11 if this vertical deflection has not been overcome. In particular, it will be seen that each swath 15 will have a rounded or convex configuration produced by the upward deflection of the cord member 11, whereas what is desired is a flat appearance or shape.

Referring now to Figures 7-10, there may be seen a modified form of the cutting assembly 8 previously depicted in Figures 2-4, wherein special provision has been made to support the cord member 11 against such deflection. In particular, it will be seen that the cord member 11 is supported within a mounting bracket 19 having a channel portion sufficient to support at least 50% of the overall length of the cord member 11, and which is further provided with flared or curved curvilinear side wall line-bearing surfaces 20 at the exit portion of the bracket 19, whereby the cutting line will be supported in a curvilinear manner in the event that such deflection does occur. The purpose of these curvilinear surfaces 20 is not to support the cutting line 11 against deflection, but to provide that if such deflection occurs, the cord member 11 will have a curvilinear configuration and will therefore not be subject to abnormal breakage which will result if the line member

11 is angularly deformed.

Referring again to Figure 8, it will be seen that in this form of the invention the cutting member 11 is preferably supported in a horizontal position relative to the rim of the plate members 10, which has been found to produce a better cutting result than when the cutting line or cord member 11 is directed in a downward manner, as suggested in the apparatus depicted in Figures 2-4.

As hereinbefore stated, it is an object of this invention to provide a lawn mower having flexible, non-metallic cutting elements instead of the conventional rigid metal blade, in order to achieve safety to not only the operator but also to persons and property within its vicinity. It is also an object of the present invention to provide a lawn mower of this type which will also achieve effective cutting.

The Weed Eater edger/trimmer has shown that a flexible non-metallic cord can be used to cut vegetation. As hereinbefore explained, the rigid metal blade cannot be replaced by a cutting head of the type employed by the Weed Eater edger for the following reasons. In the first place, flexible cords tend to be deflected upwardly from the cutting plane by the grass sought to be cut. Furthermore, the extent of such upward deflection will not only increase as a function of the amount of vegetation encountered, but

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also as a function of the forward velocity of the lawn mower assembly across the greensward. This problem has not previously been encountered with apparatus of the type exemplified by the Weed Eater trimmer, because an edger/trimmer is moved more slowly during its use, and also because the operator of a Weed Eater trimmer tends to compensate for this effect by instinctively changing its cutting plane, whereas a rotary lawn mower may not be manipulated by its operator so as to change the position of its cutting plane.

In addition to this problem, it should be noted that flexible non-metallic cords tend to produce a blowing effect which, in turn, tends to blow the grass away from the tips of the cutting lines. This, in turn, tends to cause the grass to lie down in front of the mower, which also tends to restrict its effectiveness as a cutting device. The rigid blade in a conventional rotary-type lawn mower is formed to act as a fan to draw the grass upwardly into the blade, but this advantage is not present with a lawn mower employing flexible cords as its cutting elements.

Another problem arises from the fact that the flexible cords tend to yield to the grass which they encounter. A steel blade will not yield but instead will tend to be retarded within its cutting plane, with the result being that the motor will bog down and perhaps even die. A flexible non-metallic cord will, in contrast, be directed in a horizontal manner and will yield to the uncut grass rather than to stall the motor. In this event, the motor tends to continue operating but with ineffective cutting results as the mower moves either more rapidly into the grass sought



to be cut, or in the event that it encounters denser vegetation. Also, a collateral disadvantage is that the cords tend to become abraded because of friction with uncut grass.

It has been proposed to tilt the cutting plane of the mower as a function of its forward speed in order to overcome this problem. However, such a solution to the problem would require complex and expensive apparatus, thereby greatly limiting the desirability of a lawn mower employing flexible cords as cutting elements.

It is now understood that cutting effectiveness of a flexible non-metallic cord is primarily a function of impact, and that impact, in turn, is primarily a function of velocity and mass of the tip of the revolving cord. The mass, of course, is primarily a function of the diameter of the cutting tip, since the non-metallic cord is of a relatively light weight.

It has been proposed to overcome the foregoing problems by increasing cutting velocity, and this is beneficial to a point. However, increasing cord velocity also requires an increase in power which, in turn, is obviously disadvantageous. Second, increasing the cord velocity without also increasing the cord mass can only be accomplished up to the point where the extended portion of cutting line tends to lag rotation of the plate member because of wind resistance.

The foregoing problems may also be attached by increasing the mass of the cutting tip of the cord, i.e., by increasing its diameter. If the diameter is increased, however, this also compels an increase in power merely to

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maintain the pre-established velocity, and also windage (wind resistance) is a special problem with a cord formed of a light-weight material such as nylon. Increasing the diameter and the tip velocity of the cutting cord will, of course, be helpful, but this not only requires additional power but also increases the wear to be experienced by the cutting lines. In addition, an increase in tip velocity will also create problems of vibration and friction within the overall assembly.

10        These problems are overcome with apparatus of the type best embodied by the plate member depicted in Figures 7-10, whereby the extended portion of the cutting lines 11 projects from apertures in the periphery of the plate member 10, and whereby these apertures are defined by curvilinear line bearing surfaces 20, as hereinbefore explained. A further feature is to limit the extended length of the cutting line 11 to a length whereby the stiffness of the line is sufficient to aid in avoiding deflection, and yet whereby the flexibility is sufficient to avoid creating safety problems. More important, however, is the fact that the extended portion of the line should not be greater than the portion of the line secured along its length by the support member 19. A particularly suitable length has been found to be approximately 1-1/4", and therefore at least 1-1/4" of line should be enclosed within the support member 19. The length of the cutting line 11 is, of course, a function of its diameter, and these dimensions have been found most suitable with respect to a cutting line 11 having a diameter of 0.100".

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A rotary-type lawn mower of the kind having a wheeled chassis adapted to travel over a greensward and carrying a motor having a rotatable shaft characterised by the provision therein of:

a head member having at least one peripheral aperture and mounted on said shaft for rotation in a cutting path aligned substantially parallel with said greensward and intersecting vegetation thereon,

at least one non-metallic cord-like cutting member disposed partially in said head member and having a finger-like free travelling end portion extending from said aperture outwardly of said head member into said cutting path, and

support means having an elongate passageway connecting with, and extending within said head member from, said aperture for restraining an adjacent portion of said cutting member along a length sufficient to support said free travelling end portion of said cutting member against deflection from said cutting path by said vegetation.

2. A lawn mower according to claim 1, wherein:

said support means defines an elongated channel, and  
said cord-like member extends through said channel with a free portion thereof extending substantially radially beyond the outer periphery of said head member.

3. A lawn mower according to claim 1, wherein:

said support means defines an elongated channel,  
said cord-like member extends through said channel with a free portion thereof extending substantially radially beyond the outer periphery of said head member, and

curvilinear surface means is defined by said support means and provides support for said cord-like member upon

deflection of said cord-like member within said cutting path.

4. A lawn mower according to claim 3, wherein:

said curvilinear surface means is defined by opposed curvilinear surfaces flaring outwardly from said channel.

5. A lawn mower according to claim 2, wherein said head member includes:

cord abutment means being formed to define at least one aperture, said aperture being disposed in registry with said channel, and

said cord-like element being of elongated configuration having an enlargement formed at the radially inward extremity thereof, said enlargement engaging said cord abutment and retaining said cord-like element in assembly with said head member against the effect of centrifugal force developed on said cord-like element during rotation of said head member.

6. A lawn mower according to claim 5, wherein said enlargement is a knot formed in said cord-like element.

7. A lawn mower according to claim 4, wherein the flaring is greater in the direction of the cutting path than in the vertical.

8. A lawn mower according to claim 7, wherein 30%-70% of the length of said cord-like member is supported by said support means.

9. A lawn mower according to claim 1, wherein said head member is of unitary construction and comprises a lower dish-like plate member, an upper ring-like member, and the support means being enclosed by the upper and lower members, said support means having a channel extending therethrough, the cord-like member being located in said channel and having a portion extending outwardly of the periphery of the support means to a predetermined length.

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10. A lawn mower according to claim 9, wherein the upper and lower members are located in a substantially horizontal plane.
  11. A lawn mower according to claim 10, wherein said support means is flared at the exit end of the channel.
  12. A lawn mower according to claim 1, including means for cutting the cord-like member to a preselected length.
  13. A lawn mower according to claim 1, wherein the head member includes upper and lower surfaces, the lower surface thereof being free of protuberances.
  14. A lawn mower according to claim 1, wherein the cutting member has a length of at least twice its greatest width.
  15. A lawn mower according to claim 14, wherein the cutting member has a cross-sectional dimension of at least 0.100 inch at its free end in contact with the vegetation being cut.
  16. A lawn mower according to claim 1, wherein the cutting member extends radially beyond the head member by not greater than about 50 percent of its length.
  17. A lawn mower according to claim 1, wherein said cutting member is positioned in said head member with the free-travelling end portion inclined downwardly toward the ground's surface.
  18. A lawn mower according to claim 1, wherein the cutting member has between about 30 to 70 percent of its length held against vertical deflection by said support means on said head member.
  19. A lawn mower according to claim 1, wherein said cutting member extends radially beyond said head member about 1-1/4 inches.

20. A lawn mower according to claim 1, wherein said head member is a disc having a diameter between about 15 and about 19 inches and said cutting member defines a vegetation-cutting swath between about 18 and 22 inches in width, respectively.

DATED this 15TH day of JUNE, 1979

WEED EATER, INC.

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Fellow Institute of Patent Attorneys of Australia  
of SHELSTON WATERS.

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FIG. 1

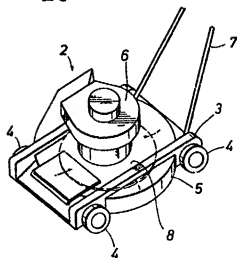


FIG. 4

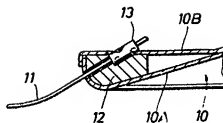


FIG. 2

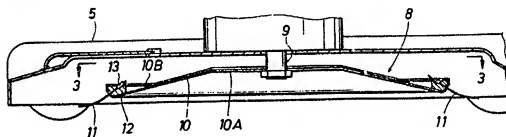
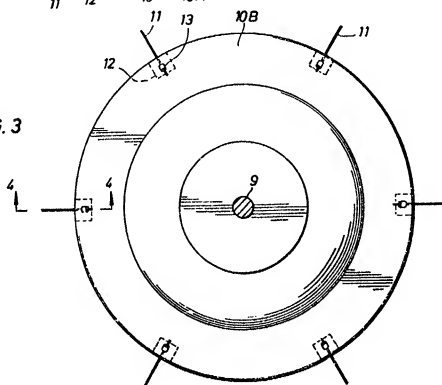


FIG. 3



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FIG. 5

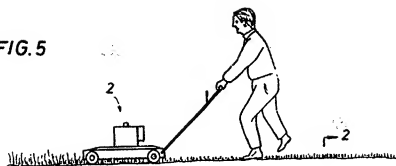


FIG. 6

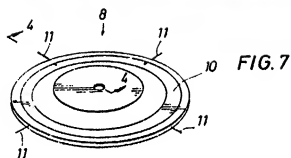


FIG. 7

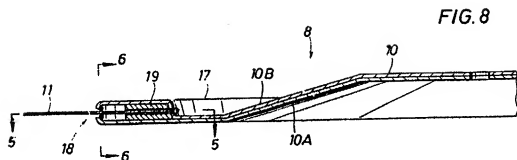


FIG. 8

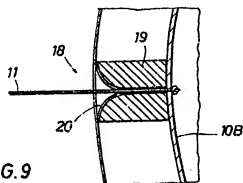


FIG. 9

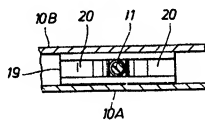


FIG. 10